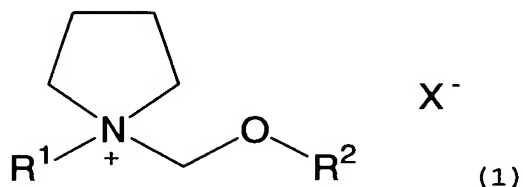


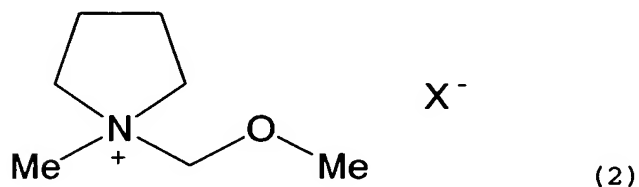
CLAIMS

1. A quaternary ammonium salt of the formula (1)



- 5 wherein R¹ is straight-chain or branched alkyl having 1 to 4 carbon atoms, R² is methyl or ethyl, and X⁻ is a fluorine-containing anion.

2. A quaternary ammonium salt of the formula (2)



wherein X⁻ is a fluorine-containing anion, and Me is methyl.

- 10 3. A quaternary ammonium salt according to claim 1 or 2 which is characterized in that the anion component X⁻ is one of CF₃CO₂⁻, CF₃SO₃⁻, N(CF₃SO₂)₂⁻, N(CF₃CF₂SO₂)₂⁻, C(CF₃SO₂)₃⁻, N(CF₃SO₂)(CF₃CO)⁻, BF₄⁻ and PF₆⁻.

4. A quaternary ammonium salt according to claim 1 or 2
15 which is characterized in that the anion component X⁻ is N(CF₃SO₂)₂⁻ or BF₄⁻.

5. A quaternary ammonium salt according to claim 2 which is characterized in that the anion component X⁻ is BF₄⁻.

6. A composition characterized in that the composition
20 comprises at least one of quaternary ammonium salts according to any one of claims 1 to 5 and an organic solvent.

7. A composition according to claim 6 which is characterized

in that the organic solvent comprises one or at least two organic solvents selected from among cyclic carbonic acid esters, chain carbonic acid esters, nitrile compounds and sulfone compounds.

8. A composition according to claim 6 which is characterized
5 in that the organic solvent comprises one or at least two organic solvents selected from among propylene carbonate, dimethyl carbonate, ethylmethyl carbonate, acetonitrile and sulfolane.

9. A composition according to claim 6 which is characterized in that the organic solvent is propylene carbonate.

10 10. A composition according to claim 6 which is characterized in that the organic solvent is dimethyl carbonate.

11. A composition according to claim 6 which is characterized in that the organic solvent is ethylmethyl carbonate.

12. A composition according to claim 6 which is
15 characterized in that the organic solvent is acetonitrile.

13. A composition according to claim 6 which is characterized in that the organic solvent is a mixture of at least two organic solvents selected from among propylene carbonate, ethylene carbonate, dimethyl carbonate and ethylmethyl carbonate.

20 14. A composition according to claim 6 which is characterized in that the organic solvent is an organic solvent mixture comprising dimethyl carbonate and ethylmethyl carbonate.

15. A composition characterized in that the composition comprises at least one quaternary ammonium salt according to claim
25 4 or 5 and an organic solvent.

16. A composition according to claim 15 which is characterized in that the organic solvent comprises one or at least two organic solvents selected from among cyclic carbonic acid

esters, chain carbonic acid esters, nitrile compounds and sulfone compounds.

17. A composition according to claim 15 which is characterized in that the organic solvent comprises one or at least
5 two organic solvents selected from among propylene carbonate, ethylene carbonate, dimethyl carbonate, ethylmethyl carbonate, acetonitrile and sulfolane.

18. A composition according to claim 15 which is characterized in that the organic solvent is propylene carbonate.

10 19. A composition according to claim 15 which is characterized in that the organic solvent is dimethyl carbonate.

20. A composition according to claim 15 which is characterized in that the organic solvent is ethylmethyl carbonate.

15 21. A composition according to claim 15 which is characterized in that the organic solvent is acetonitrile.

22. A composition according to claim 15 which is characterized in that the organic solvent is a mixture of at least two organic solvents selected from among propylene carbonate, ethylene carbonate, dimethyl carbonate and ethylmethyl carbonate.

20 23. A composition according to claim 15 which is characterized in that the organic solvent is an organic solvent mixture comprising dimethyl carbonate and ethylmethyl carbonate.

24. A composition characterized in that the composition contains a quaternary ammonium salt according to claim 5 and at
25 least one organic solvent selected from among propylene carbonate, ethylene carbonate, dimethyl carbonate and ethylmethyl carbonate.

25. A composition comprising a quaternary ammonium salt according to claim 5 and dimethyl carbonate.

26. A composition according to claim 25 which is characterized in that the composition contains at least 40 wt. % of the quaternary ammonium salt according to claim 5.

27. A composition comprising a quaternary ammonium salt according to claim 5 and ethylmethyl carbonate.

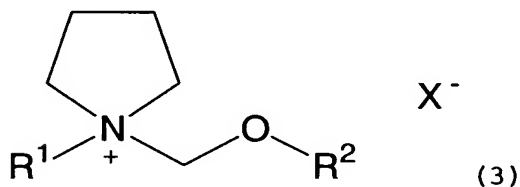
28. A composition according to claim 27 which is characterized in that the composition contains at least 65 wt. % of the quaternary ammonium salt according to claim 5.

29. A composition comprising a quaternary ammonium salt according to claim 5, dimethyl carbonate and ethylmethyl carbonate.

30. A composition comprising a quaternary ammonium salt according to claim 5 and propylene carbonate.

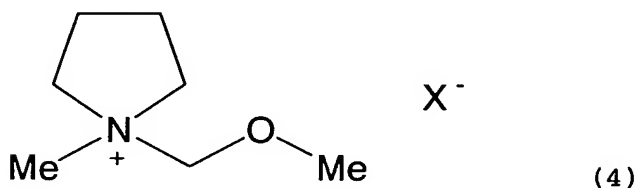
31. A composition according to claim 30 which is characterized in that the composition contains 20 to 60 wt. % of the quaternary ammonium salt according to claim 5.

32. An electrolyte of the formula (3)



wherein R¹ is straight-chain or branched alkyl having 1 to 4 carbon atoms, R² is methyl or ethyl, and X⁻ is a fluorine-containing anion.

33. An electrolyte of the formula (4)



wherein X⁻ is a fluorine-containing anion, and Me is methyl.

34. An electrolyte according to claim 32 or 33 which is characterized in that the anion component X^- is one of $CF_3CO_2^-$, $CF_3SO_3^-$, $N(CF_3SO_2)_2^-$, $N(CF_3CF_2SO_2)_2^-$, $C(CF_3SO_2)_3^-$, $N(CF_3SO_2)(CF_3CO)^-$, BF_4^- and PF_6^- .

5 35. An electrolyte according to claim 32 or 33 which is characterized in that the anion component X^- is $N(CF_3SO_2)_2^-$ or BF_4^- .

36. An electrolyte according to claim 33 which is characterized in that the anion component X^- is BF_4^- .

37. An electrolytic solution for use in electrochemical
10 devices which is characterized in that the solution contains at least one electrolyte according to any one of claims 32 to 36.

38. An electrolytic solution for use in electrochemical devices which is characterized in that the solution comprises at least one electrolyte according to any one of claims 32 to 36 and
15 an organic solvent.

39. An electrolytic solution for use in electrochemical devices which is characterized in that at least one electrolyte according to any one of claims 32 to 36 is dissolved at a concentration of at least 0.1 M in an organic solvent.

20 40. An electrolytic solution for use in electrochemical devices according to claim 37 or 39 which is characterized in that the solution has added thereto an electrolyte other than the electrolyte according to any one of claims 32 to 36.

41. An electrolytic solution for use in electrochemical
25 devices according to claim 38 which is characterized in that the organic solvent comprises one or at least two organic solvents selected from among cyclic carbonic acid esters, chain carbonic acid esters, nitrile compounds and sulfone compounds.

42. An electrolytic solution for use in electrochemical devices according to claim 38 which is characterized in that the organic solvent comprises one or at least two organic solvents selected from among propylene carbonate, ethylene carbonate, dimethyl carbonate, ethylmethyl carbonate, acetonitrile and sulfolane.

43. An electrolytic solution for use in electrochemical devices according to claim 38 which is characterized in that the organic solvent is propylene carbonate.

44. An electrolytic solution for use in electrochemical devices according to claim 38 which is characterized in that the organic solvent is dimethyl carbonate.

45. An electrolytic solution for use in electrochemical devices according to claim 38 which is characterized in that the organic solvent is ethylmethyl carbonate.

46. An electrolytic solution for use in electrochemical devices according to claim 38 which is characterized in that the organic solvent is acetonitrile.

47. An electrolytic solution for use in electrochemical devices according to claim 38 which is characterized in that the organic solvent is a mixture of at least two organic solvents selected from among propylene carbonate, ethylene carbonate, dimethyl carbonate and ethylmethyl carbonate.

48. An electrolytic solution for use in electrochemical devices according to claim 38 which is characterized in that the organic solvent is an organic solvent mixture comprising dimethyl carbonate and ethylmethyl carbonate.

49. An electrolytic solution for use in electrochemical

devices which comprises the electrolyte according to claim 36 and dimethyl carbonate.

50. An electrolytic solution for use in electrochemical devices according to claim 49 which is characterized in that the solution contains at least 40 wt. % of the electrolyte according to claim 36.

51. An electrolytic solution for use in electrochemical devices which comprises the electrolyte according to claim 36 and ethylmethyl carbonate.

10 52. An electrolytic solution for use in electrochemical devices according to claim 51 which is characterized in that the solution contains at least 65 wt. % of the electrolyte according to claim 36.

15 53. An electrolytic solution for use in electrochemical devices which comprises an electrolyte according to claim 36, dimethyl carbonate and ethylmethyl carbonate.

54. An electrolytic solution for use in electrochemical devices which comprises an electrolyte according to claim 36 and propylene carbonate.

20 55. An electrolytic solution for use in electrochemical devices according to claim 54 which is characterized in that the solution contains 20 to 60 wt. % of the electrolyte according to claim 36.

25 56. An electrolytic solution for use in electric double-layer capacitors which is characterized in that the solution contains at least one of electrolytes according to any one of claims 32 to 36.

57. An electrolytic solution for use electric double-layer

capacitors which is characterized in that the solution comprises at least one electrolyte according to any one of claims 32 to 36 and an organic solvent.

58. An electrolytic solution for use in electric double-
5 layer capacitors according to claim 57 which is characterized in that the organic solvent comprises one or at least two organic solvents selected from among cyclic carbonic acid esters, chain carbonic acid esters, nitrile compounds and sulfone compounds.

59. An electrolytic solution for use in electric double-
10 layer capacitors according to claim 57 which is characterized in that the organic solvent comprises one or at least two organic solvents selected from among propylene carbonate, dimethyl carbonate, ethylmethyl carbonate, acetonitrile and sulfolane.

60. An electrolytic solution for use in electric double-
15 layer capacitors according to claim 57 which is characterized in that the organic solvent is propylene carbonate.

61. An electrolytic solution for use in electric double-
layer capacitors according to claim 57 which is characterized in that the organic solvent is dimethyl carbonate.

20 62. An electrolytic solution for use in electric double-
layer capacitors according to claim 57 which is characterized in that the organic solvent is ethylmethyl carbonate.

63. An electrolytic solution for use in electric double-
layer capacitors according to claim 57 which is characterized in
25 that the organic solvent is acetonitrile.

64. An electrolytic solution for use in electric double-
layer capacitors according to claim 57 which is characterized in that the organic solvent is a mixture of at least two organic

solvents selected from among propylene carbonate, dimethyl carbonate and ethylmethyl carbonate.

65. An electrolytic solution for use in electric double-layer capacitors according to claim 57 which is characterized in
5 that the organic solvent is an organic solvent mixture comprising dimethyl carbonate and ethylmethyl carbonate.

66. An electrolytic solution for use in electric double-layer capacitors which is characterized in that the solution contains the electrolyte according to claim 36, and at least one
10 organic solvent selected from among propylene carbonate, dimethyl carbonate and ethylmethyl carbonate.

67. An electrolytic solution for use in electric double-layer capacitors which is characterized in that the solution contains the electrolyte according to claim 36, and at least one
15 organic solvent selected between dimethyl carbonate and ethylmethyl carbonate.

68. An electrolytic solution for use in electric double-layer capacitors which comprises the electrolyte according to claim 36 and propylene carbonate.

20 69. An electrolytic solution for use in electric double-layer capacitors which comprises the electrolyte according to claim 36 and dimethyl carbonate.

70. An electrolytic solution for use in electric double-layer capacitors according to claim 69 which is characterized in
25 that the solution contains at least 40 wt. % of the electrolyte according to claim 36.

71. An electrolytic solution for use in electric double-layer capacitors which comprises the electrolyte according to claim

36 and ethylmethyl carbonate.

72. An electrolytic solution for use in electric double-layer capacitors according to claim 71 which is characterized in that the solution contains at least 65 wt. % of the electrolyte
5 according to claim 36.

73. An electrolytic solution for use in electric double-layer capacitors which comprises an electrolyte according to claim 36, dimethyl carbonate and ethylmethyl carbonate.

74. An electrolytic solution for use in electric double-
10 layer capacitors which comprises an electrolyte according to claim 36 and propylene carbonate.

75. An electrolytic solution for use in electric double-layer capacitors according to claim 74 which is characterized in that the solution contains 20 to 60 wt. % of the electrolyte
15 according to claim 36.

76. An electrolytic solution for use in lithium secondary cells which is characterized in that the solution comprises at least one of electrolytes according to any one of claims 32 to 36 and a lithium salt electrolyte.

20 77. An electrolytic solution for use in lithium secondary cells which is characterized in that the solution comprises at least one electrolyte according to any one of claims 32 to 35, a lithium salt electrolyte and an organic solvent.

78. An electrolytic solution for use in lithium secondary
25 cells according to claim 77 which is characterized in that the organic solvent comprises one or at least two organic solvents selected from among cyclic carbonic acid esters, chain carbonic acid esters, cyclic ethers, chain ethers, nitrile compounds and

sulfone compounds.

79. An electrolytic solution for use in lithium secondary cells according to claim 77 which is characterized in that the organic solvent comprises one or at least two organic solvents
5 selected from among propylene carbonate, ethylene carbonate, dimethyl carbonate, ethylmethyl carbonate, acetonitrile, sulfolane, 1,2-dimethoxyethane and tetrahydrofuran.

80. An electrolytic solution for use in lithium secondary cells according to claim 77 which is characterized in that the
10 organic solvent is a mixture of at least two organic solvents selected from among ethylene carbonate, dimethyl carbonate, ethylmethyl carbonate, 1,2-dimethoxyethane and tetrahydrofuran.

81. An electrolytic solution for use in lithium secondary cells according to claim 77 which is characterized in that the
15 organic solvent is a solvent mixture comprising ethylene carbonate and dimethyl carbonate.

82. An electrolytic solution for use in lithium secondary cells according to claim 77 which is characterized in that the organic solvent is a solvent mixture comprising ethylene carbonate
20 and ethylmethyl carbonate.

83. An electrolytic solution for use in lithium secondary cells according to claim 77 which is characterized in that the organic solvent is ethylene carbonate.

84. An electrolytic solution for use in lithium secondary
25 cells according to claim 77 which is characterized in that the organic solvent is dimethyl carbonate.

85. An electrolytic solution for use in lithium secondary cells according to claim 77 which is characterized in that the

organic solvent is ethylmethyl carbonate.

86. An electrochemical device characterized in that the device comprises the electrolytic solution according to any one of claims 37 to 55.

5 87. An electrochemical device according to claim 86 which is characterized in that the device is an electric double-layer capacitor or secondary cell.

10 88. An electric double-layer capacitor characterized in that the capacitor comprises the electrolytic solution according to claim 56.

89. An electric double-layer capacitor characterized in that the capacitor comprises the electrolytic solution according to claim 57.

15 90. An electric double-layer capacitor characterized in that the capacitor comprises the electrolytic solution according to claim 58.

91. An electric double-layer capacitor characterized in that the capacitor comprises the electrolytic solution according to claim 59.

20 92. An electric double-layer capacitor characterized in that the capacitor comprises the electrolytic solution according to claim 60.

25 93. An electric double-layer capacitor characterized in that the capacitor comprises the electrolytic solution according to claim 61.

94. An electric double-layer capacitor characterized in that the capacitor comprises the electrolytic solution according to claim 62.

95. An electric double-layer capacitor characterized in that the capacitor comprises the electrolytic solution according to claim 63.

5 96. An electric double-layer capacitor characterized in that the capacitor comprises the electrolytic solution according to claim 64.

97. An electric double-layer capacitor characterized in that the capacitor comprises the electrolytic solution according to claim 65.

10 98. An electric double-layer capacitor characterized in that the capacitor comprises the electrolytic solution according to claim 66.

15 99. An electric double-layer capacitor characterized in that the capacitor comprises the electrolytic solution according to claim 67.

100. An electric double-layer capacitor characterized in that the capacitor comprises the electrolytic solution according to claim 68.

20 101. An electric double-layer capacitor characterized in that the capacitor comprises the electrolytic solution according to claim 69.

102. An electric double-layer capacitor characterized in that the capacitor comprises the electrolytic solution according to claim 70.

25 103. An electric double-layer capacitor characterized in that the capacitor comprises the electrolytic solution according to claim 71.

104. An electric double-layer capacitor characterized in

that the capacitor comprises the electrolytic solution according to claim 72.

105. An electric double-layer capacitor characterized in that the capacitor comprises the electrolytic solution according to
5 claim 73.

106. An electric double-layer capacitor characterized in that the capacitor comprises the electrolytic solution according to claim 74.

107. An electric double-layer capacitor characterized in
10 that the capacitor comprises the electrolytic solution according to claim 75.

108. A lithium secondary cell characterized in that the cell comprises the electrolytic solution for use in lithium secondary cells according to claim 76.

15 109. A lithium secondary cell characterized in that the cell comprises the electrolytic solution for use in lithium secondary cells according to claim 77.

110. A lithium secondary cell characterized in that the cell comprises the electrolytic solution for use in lithium secondary
20 cells according to claim 78.

111. A lithium secondary cell characterized in that the cell comprises the electrolytic solution for use in lithium secondary cells according to claim 79.

112. A lithium secondary cell characterized in that the cell
25 comprises the electrolytic solution for use in lithium secondary cells according to claim 80.

113. A lithium secondary cell characterized in that the cell comprises the electrolytic solution for use in lithium secondary

cells according to claim 81.

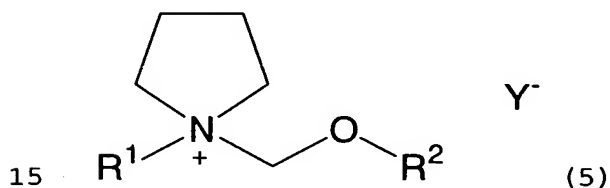
114. A lithium secondary cell characterized in that the cell comprises the electrolytic solution for use in lithium secondary cells according to claim 82.

5 115. A lithium secondary cell characterized in that the cell comprises the electrolytic solution for use in lithium secondary cells according to claim 83.

116. A lithium secondary cell characterized in that the cell comprises the electrolytic solution for use in lithium secondary
10 cells according to claim 84.

117. A lithium secondary cell characterized in that the cell comprises the electrolytic solution for use in lithium secondary cells according to claim 85.

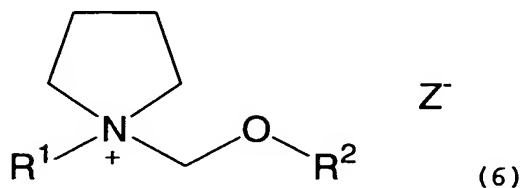
118. A quaternary ammonium salt of the formula (5)



wherein R¹ is straight-chain or branched alkyl having 1 to 4 carbon atoms, R² is methyl or ethyl, and Y⁻ is Cl⁻, Br⁻, I⁻ or MeOCO₂⁻.

119. A quaternary ammonium salt according to claim 118 wherein R¹ and R² are methyl.

20 120. A quaternary ammonium salt of the formula (6)

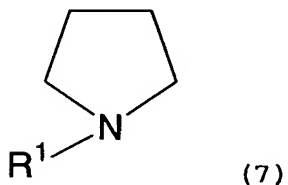


wherein R¹ is straight-chain or branched alkyl having 1 to 4 carbon

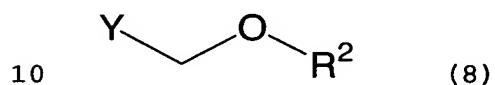
atoms, R^2 is methyl or ethyl, and Z^- is $1/2CO_3^{2-}$, HCO_3^- , $1/2SO_4^{2-}$, ClO_4^- , $CH_3CO_2^-$ or OH^- .

121. A quaternary ammonium salt according to claim 120 wherein R^1 and R^2 are methyl.

5 122. A process for preparing a quaternary ammonium salt of the formula (5) comprising reacting an alkylpyrrolidine of the formula (7) and a compound of the formula (8)

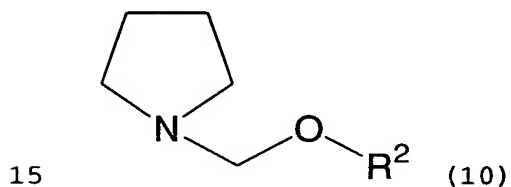


wherein R^1 is same as above



wherein R^2 and Y are same as above.

123. A process for preparing a quaternary ammonium salt of the formula (5) comprising reacting an alkoxy-pyrrolidine of the formula (10) and a compound of the formula (11)

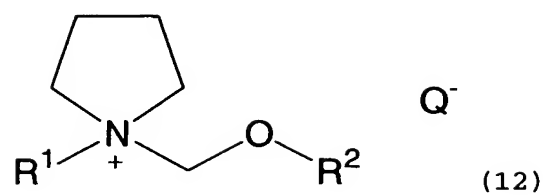


wherein R^2 is same as above



wherein R^1 and Y are same as above.

124. A quaternary ammonium salt of the formula (12)



wherein R^1 is straight-chain or branched alkyl having 1 to 4 carbon atoms, R^2 is methyl or ethyl, Q^- is $R^1\text{OCO}_2^-$.

125. A quaternary ammonium salt according to claim 124

5 wherein R^1 and R^2 are methyl.